## REMARKS

Claims 24-26, 28-37, 79-82, 85-95, 99-103, 107-110, 112-118, 122-124, 127-129, 135, 139, 140, 142 and 143 were examined in the outstanding non-final office action mailed on 01/10/2008 (hereafter "Outstanding Office Action"). All the claims were rejected.

Before addressing the rejections, Applicants and the undesigned representative thank the Examiner for the detailed examination report(s) and the thorough examination.

By virtue of this paper, claims 24, 28-31, 79, 95, 99, 103, 107, 110, 112, 115, 118, 122-124, 135 and 142-143 are sought to be amended. The amendments are believed not to introduce new matter and their entry is respectfully requested. The amendments are made without prejudice or disclaimer.

Claims 24-26, 28-37, 79-82, 85-95, 99-103, 107-110, 112-118, 122-124, 127-129, 135, 139-140 and 142-143 are thus respectfully presented for consideration further in view of the below remarks.

### *Claim Rejections - 35 U.S.C. § 112, Second Paragraph*

In Paragraph 2 Page 2 of the Outstanding Office Action, claims 28-29, 81-82, 112-113 and 142-143 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In this regard, it was further stated that:

> In particular Referring to claims 28, 81, 112, & 124; what is meant by "wherein said second information element comprises a non-mandatory information element according to a signaling specification used for signaling in said ATM network, wherein non mandatory information elements can be ignored by said plurality of switches when processing signaling message according to said signaling specification?"
>
> Referring to claim 142, what is meant by "mandatory information elements and a non-mandatory information element according to a signaling protocol.
>
> (Page 2, lines 8-14 of the Outstanding Office Action)

Applicants point to some of the relevant parts of the specification and the standards noted in the specification, which are believed to clarify the meaning requested in the above quoted paragraphs.

> Edge routers interface with switches at the edge using

> protocols such as UNI (***User to Network Interface 3.1 or 4.0***) during signaling. The interface between switches may be implemented using protocols such as NNI (network to network interface) during signaling. In general, both the types of signaling messages contain information specifying the parameters used in provisioning the virtual circuits. For example, a typical signaling set up message using ***UNI/NNI includes information elements*** identifying the called party, service parameters, etc. (Page 12 lines 4-5 of the specification, ***Emphasis Added***)
>
> ...
>
> In an embodiment, the format (including information elements) of group set up request is designed such that a device (switch or edge router) may be able to ***ignore the portions*** related to groups (as ***optional*** non-mandatory ***information elements***), and indicate acceptance for a single virtual circuit. (Page 13, lines 1-3 of the specification, ***Emphasis Added***)

Thus, the specification clearly sets forth the use of UNI/NNI as signaling protocols/ specifications and the use of **optional (or non-mandatory)** information elements according to these specifications.

The terms **optional** (non-mandatory) and **mandatory information elements are terms of art**, as evidenced by the numerous references to these terms at least in UNI 4.0 specification entitled, "ATM User-Network Interface (UNI) Signalling Specification Version 4.0: af-sig-0061.000" (hereafter "UNI 4.0 Specification"), a copy of which has been submitted in the information disclosure statement (IDS) filed on 02-07-2002. For example, it is taught there that:

> **1.2 UNI 4.0 Capabilities**
>
> Table 1-2 shows the capabilities available within the ATM Forum UNI Signalling Specification, 4.0. Capabilities are listed as applicable to a terminal equipment and a network node (switching system) and are ***categorized as mandatory (M) or optional (O)***.
>
> Implementations claiming conformance to the UNI Signalling Specification, Version 4.0, ***shall support the capabilities listed as Mandatory in table 1-2; i.e., by implementing the procedures of the corresponding sections of this Specification***. Some capabilities that are categorized as mandatory in this Specification are not provided in the UNI 3.1 Specification, the B-ICI 2.0 Specification and/or the relevant ITU-T Recommendations. Procedures are provided in this Specification to support interworking across such interfaces. ***UNI Signalling 4.0 implementations shall support at least these procedures and recognize the corresponding information elements***. (Page number 1 line last 4 lines and page 2 first 4 lines of the UNI 4.0 specification, ***Emphasis Added***)

Thus, one skilled in the relevant arts in possession of the information in the subject

specification and at least the UNI 4.1 specification would understand that the term mandatory implies that the corresponding information elements **shall be recognised**.

**Optional** (at least when read in the context of mandatory) would imply that the corresponding information elements **need not be recognised/processed/supported.**

It accordingly follows that, when a switch receives a signaling message with an optional information element **that is not supported/implemented in the switch**, no action need be taken in response (or **ignored**). This would be within the knowledge of one skilled in the relevant arts given that UNI 4.1 specification corresponds to a standard adopted by the ATM community.

Ignoring an information element implies that the switches **need not perform any action** when the information element is received in a signaling packet in an ATM switch. Switches which do not support the novel information elements of the present invention (or optional information elements, in general, for that matter) merely ignore these information elements, when they are received in a signaling message.

It is pertinent to note that UNI 4.0 Specification is dated July 1996 (a few years earlier than the filing date of the subject application) and thus a skilled practitioner would appreciate readily the meaning of the terms requested in the Outstanding Office Action.

Withdrawal of the objections under 35 U.S.C. § 112, first paragraph, as against claims 28-29, 81-82, 112-113 and 142-143 is respectfully requested.

### *Claim Rejections - 35 U.S.C. § 112, First Paragraph*

In page 2, paragraph 4 of the Outstanding Office Action, claims 28-29, 81-82, 112-113, 142-143 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. It was further alleged that the claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the

invention.

Several questions were posed in this regard and Applicants address each of these questions.

Applicants first note that the hypothetical skilled practitioner (for analysis of the enablement requirement) would be in possession of at least the teachings of the subject specification and UNI 4.1 standard noted above. The combined information is believed to satisfy the enablement requirement of 35 U.S.C. § 112 as explained below.

With respect to claims 28, 81, 112 and 124, it was stated that, "... where in the applicant's specification, UNI spec., or NNI specification are the details about mandatory information elements and non-mandatory information elements taught?"

As explained above with respect to the rejections under 35 U.S.C. § 112, second paragraph, the combined teachings of the subject specification and UNI 4.1 standard clearly provide sufficient disclosure to one skilled in the relevant arts, as to how to implement the claimed switches in using mandatory and optional information elements.

It was further stated that, "... Where in the applicant's specification, UNI spec., or NNI specification are the details about how non-mandatory information elements are ignored?"

Again, as explained above with respect to the rejections under 35 U.S.C. § 112 second paragraph, the term 'optional or non-mandatory information elements' implies that the information element need not be supported (and thus can be ignored, requiring no action when the information element is received in a signaling message). Such a construction finds further support in at least in the below portion of the specification:

> In case any of the devices in the virtual circuit path do not support group of virtual circuits, the corresponding device may ignore the new information element (as being non-mandatory) and accept a single virtual circuit corresponding to the conventional information element. Accordingly, a response message (propagated back to edge router 120) would indicate that only one virtual circuit has been accepted.
> (Page 17, lines 6-10 of the specification)

Similar explanation applies to the rejection with respect to claim 142.

For the benefit of the Examiner, the use of mandatory and optional information elements is explained with an example assuming that a switch X (SX) wishes to setup multiple virtual circuits to a switch Y (SY) and there are 3 intermediate switches (S1, S2 and S3) in the path from SX to SY. For illustration, it is assumed that S1 and S2 support setup of multiple virtual circuit in response to a single signaling message and S3 does not provide such support.

It is further assumed that each of the switches S1, S2 and S3 are provided with the ability to support the conventional mandatory information element. That is, in response to receiving a signaling message with the conventional mandatory information element (with or without the non-mandatory information element(s)), each of the switches is designed to accept/setup a single virtual circuit.

Accordingly, switch SX may send a single signaling message of the present invention containing a conventional mandatory information element requiring setup of a single virtual circuit of a group of virtual circuits, and one or more additional non-mandatory information elements requesting setup of the remaining ones of the group of virtual circuits.

Switch S3 would accept a single virtual circuit in response to the conventional mandatory information element, while ignoring the non-mandatory (optional) information elements. Accordingly, SX would receive an acceptance message for a single virtual circuit, though setup of multiple virtual circuits are requested i the single signaling message.

Withdrawal of all the rejections under 35 U.S.C. § 112, first paragraph, as against all claims 28-29, 81-82, 112-113, 142-143 is respectfully requested.

### *Claim Rejections Under 35 U.S.C. § 102*

Claims 24, 30-35, 79-80, 85-91, 95, 99-103, 107-110, 114-118, 122-123, 127-129, 135, 139, and 140 were rejected under 35 U.S.C. § 102(e) as being anticipated by Gupta

(U.S. Patent No.: 6,278,714).

Without acquiescing to any of Examiner's contentions, it is respectfully submitted that the presented claims are allowable over Gupta.

For example, currently amended claim 24 recites the use one information element to request setup of a single virtual circuit and the use of a non-mandatory information element to request additional virtual circuits. If any of the switches in the switches in the path of the virtual circuit is not designed to process the non-mandatory information element, a single virtual circuit is accepted in response to the receipt of the one information element.

At least the portion of Gupta relied upon by the Examiner do not teach or reasonably suggest such use of non-mandatory information elements. As a basis for such an assertion, Applicants point to the below assertions in the Outstanding Office Action:

> an inbound interface designed for receiving on said ATM network a first acceptance message indicating that only said single virtual circuit setup if any of the plurality of switches in a connection path between said first end system and said second end system is designed not to support setting up said plurality of virtual circuits in response to said single signaling message, wherein said first acceptance message is received in response to sending said first signaling message to said second end system (Communication Port (385 per Fig 1) receives an ACK per col. 7 lines 1-8 which the examiner interprets as indicating what circuits can be setup and ***would only set up a single circuit if it was available which would include not being designed to support the plurality wherein Figure 7A & 7B represents the single signaling message)***
> (Pg 4 Ln 13-21 of Outstanding Office Action, ***Emphasis Added)***

Assuming arguendo that Gupta teaches setting up of a single virtual circuit only even though multiple virtual circuits are requested in a single signaling request as alleged by the Examiner, it is respectfully pointed out that the reason for setting up of a single virtual circuit is different from that recited in the currently amended claim 24.

In accordance with currently amended claim 24, the acceptance of a single virtual circuit is received due to the request for setup of additional virtual circuits using **non-mandatory information elements**, which are **not supported by one or more switches in the path**. On the other hand, the reasons of the emphasized portion of above implies that a

single virtual circuit is accepted when there is insufficient capacity in one more switches of the path.

Currently amended claim 24 is accordingly allowable over Gupta. Claims 25-26 and 28-37 depend from claim 24, and are thus allowable at least for the reasons noted above with respect to claim 24.

Currently amended claim 31 is also independently allowable over Gupta at least for some of the reasons noted below with respect to claim 79.

It is now asserted currently amended claim 79 is allowable over Gupta for several reasons. For example, currently amended claim 79 recites that an acceptance message is received for a requested number of virtual circuits, **<u>but fewer than all the requested number of virtual circuits are provisioned by switches</u>** in the path between the first ATM switch and the second ATM switch.

At least the portions of Gupta relied upon in the Outstanding Office Action do not teach of reasonably suggest such a feature. Some of the portions of Gupta relied upon by the Examiner are repeated below for the convenience of the Examiner:

> FIG. 9 is a block diagram showing the switches and links used in setting up the VCB requested in FIG. 7C and described in conjunction with FIG. 8. VCB 3 is established between switch 1 and switch 2 with 24 virtual circuits. Those 24 virtual circuits are divided up into 3 subsets with subset VCB 3A going to switch 4, subset VCB 3B going to switch 5, and subset VCB 3C going to switch 3.
>
> At this point in the example, the request of FIG. 7C has been granted and the virtual circuit bunch established as illustrated in FIG. 9. However, no traffic is flowing across the virtual circuit bunch. ***The virtual circuit bunches are allocated and set up in the controller tables and the switching tables of the switches*** but they ***are not being utilized.***
>
> Returning to FIG. 8B, column 1 of FIG. 8B shows an allocation of incoming ports and virtual circuits of switch 1 which correspond to the virtual circuit bunch VCB3 and its subsets VCB 3A and VCB 3B and VCB 3C. When a new user at switch 1 has traffic for a destination at switch 4, switch 1 will assign the user to a VC in VCB 3A which goes to switch 4. The assigned VC in VCB 3A will immediately route the traffic to switch 4 without any setup required for virtual circuits between switch 1 and switch 4. They have been preallocated. At switch 4, the destination address of a cell is used to route the cell to its

> final destination.
> (Col. 8, lines 8-32 of Gupta, ***Emphasis Added***)

It is respectfully noted that Gupta clearly teaches that **<u>all the virtual circuits in the requested bunch are provisioned</u>**, since provisioning entails setting up of the tables in the switches in the path (as is well appreciated by one skilled in the ATM technologies to which the invention relates).

The Examiner's analogy of equating such a feature (including provisioning) with 'not being utilized' also in the above emphasized language of Gupta, would be clearly erroneous since the term 'provisioned' is a term of art, which implies populating of the switching tables of Gupta. As evidence of this assertion, Applicants submit Exhibit A entitled, "A Short Introduction to ATM Concepts, Ver 1.0" (hereafter 'Exhibit A') by Jack Krupicka, Product Manager, Wandel & Goltermann Technologies, Inc., dated 4/94, available at magda.elibel.tm.fr/refs/telecom/ atmintro.pdf, which states in relevant parts:

> A PVC is created in a ***provisioning*** process that includes ***modifying the routing table of each ATM switch in the data path to provide the desired connection.*** Later ATM networks will use Signaling procedures to establish Switched Virtual Channels or SVCs, that can be set up or taken down when needed. Whether PVC or SVC, all ATM channels are connection oriented, by which we mean that a "connection" must be established in the ATM network before data can be sent.
> (Page 5, last 7 lines of Exhibit A, ***Emphasis Added***)

The switching tables of Gupta are believed to be equivalent to the routing table of Exhibit A and thus the term 'provisioning' (as understood by one skilled in the relevant arts) would entail modifying of the switching tables of Gupta.

Thus, Gupta would provision ALL the virtual circuits of a requested bunch. For this reason alone, the portions of Gupta relied upon by the Examiner in rejecting claim 79, would not anticipate currently amended claim 79.

Even assuming arguendo that the Examiner is somehow correct in finding the above noted feature of claim 79 in the above-quoted text of Gupta, it is respectfully noted that the portions of Gupta relied upon by the Examiner do not teach other features of amended claim 79.

For example, currently amended claim 79 recites in relevant parts that, "... sending a second signaling message from said first ATM switch to said second ATM switch to complete provisioning of at least one of set of inactive virtual circuits between said first ATM switch and said second ATM switch."

The Examiner relies upon Figure 17 of Gupta in finding the second signaling message. At least a part of the description related to Figure 17 is reproduced below:

> FIG. 17 is a flow chart of a process for setting up a virtual circuit using an established virtual circuit bunch in accordance with the invention. Continuing with the previous example, the switch 1 controller receives a request for a VC to a destination switch N serviced by the VCB (1700). The switch 1 controller sends a control packet to the switch N controller either over a VC of the VCB or over a control link (1710) requesting a connection to a destination address at switch N. The switch N controller enters controller table data for the <port, VCI> tuple to be used by the destination address, sets the switch table and acknowledges the connection by sending a control packet to the switch 1 controller (1720). The switch 1 controller enters the controller table data for the destination address and the originating address and sets the switch table entries (1730), ***thus establishing an end to end connection between user 1 and user 2.*** Thus, in contrast to the process described in conjunction with FIGS. 4 and 5, ***since a virtual circuit bunch has already been set up, the only action required to establish an end to end connection is at the end points of the virtual circuit bunch.*** Thus, the switch 1 controller needs only establish a connection between the requesting virtual circuit for user U1 and the virtual circuit bunch destined for switch N, and switch N needs only to establish an association between the virtual circuit bunch and the destination user U2. Thus network traffic is significantly reduced, processing at the intermediate nodes is eliminated since the virtual circuit bunch has already been set up.
> (Col. 12 line 57 to Col. 13 line 17 of Gupta, ***Emphasis Added***)

It may be appreciated that all ("plurality of" and "inactive") of the virtual circuits of currently amended claim 79 are between the same first ATM switch and the second ATM switch.

On the other hand, when viewed in terms of Figure 1 of Gupta, it is believed that the virtual circuit bunch is setup between switches A and J, while the above quoted description merely establishes a connection between users $U_1$ and $U_2$ of Figure 1.

Currently amended claim 79 is allowable over Gupta at least for one of the reasons noted above. Claims 80-82, and 85-94 depend from claim 79 and are allowable at least for reasons noted above with respect to claim 79.

Currently amended claim 95 is allowable Gupta for reasons noted above at least in reciting that acceptance is sent for the requested number of virtual circuits, but fewer than the accepted number of virtual circuits are provisioned.

Claims 99-102 depend from claim 95 and are thus allowable at least for the reasons noted above with respect to claim 95. Claims 139 and 140 depend from claim 135 and are allowable at least for the reasons noted above with respect to claim 135.

The remaining claims presented for consideration are also allowable for one or more of the reasons noted above.

Thus all the objections and rejections are believed to be overcome and the application is believed to be in condition for allowance. The Examiner is invited to telephone the undersigned representative at 707.356.4172 if it is believed that an interview might be useful for any reason.

Respectfully submitted,
/Narendra Reddy Thappeta/
Signature

Date: May 12, 2008

Printed Name: Narendra Reddy Thappeta
Attorney for Applicant
Registration Number: 41,416

**Exhibit A**
**Appli. No.: 09/976,004**

# A Short Introduction to ATM Concepts

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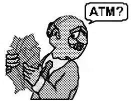
4/94 Ver 1.0

**Exhibit A**
**Appli. No.: 09/976,004**

# Introduction to ATM

**Exhibit A**
**Appli. No.: 09/976,004**

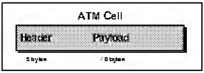
## What is this *ATM* thing, and how do I get my money?




ATM for Telecommunications is ***Asynchronous Transfer Mode***, (not Automatic Teller Machine). Division 2 will have ATM testing products available in calendar year 94, so this is the right time to start learning. ATM is a technology that has ***transport, switching, network management, and customer services*** built into it right from the start. The details of these, and how they can be tested, will be explored in this tutorial series.

## ATM is a "Cell Relay" technology

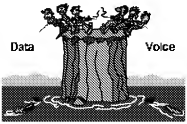
In general, ATM means that traffic is carried in small, fixed-length packets called ***cells***.




International standards call for a 53-byte cell, 5 bytes of which is a header, and 48 bytes are payload. The fixed length cell gives some key advantages from earlier packet technology. The first is that the short cells can be switched in hardware, so that ATM can be switched quickly and economically. The second advantage is that queueing delays caused by long, variable-length frames can be reduced to the wait time for a 53-byte cell, allowing time-dependent voice and video to be transported.

## Why do we need a new technology?

To answer this, let's first take a quick look at the two transport technologies available today: our traditional digital telephony system using ***Time Domain Multiplexing*** (TDM) technology, and packet switching systems like ***X.25*** or ***Frame Relay***. What are the advantages and disadvantages of each? The answers to these questions will point us directly to ATM technology.




## Time Domain Multiplexing

TDM (also referred to as ***Synchronous Tranfer Mode***, or STM) systems provide fixed bandwidth channels, illustrated here. For signals requiring ***Continuous Bit Rate*** (CBR) transport such as traditional voice and video this is ideal, but for computers with bursty traffic, this is very wasteful of network resources. Also, the granularity of the available bandwidth is very coarse. For instance, in North America, there is no standard transport bandwidth between 1.5Mbs and 45Mbs. An application requiring, say 10Mbs to accommodate bursts for Ethernet-to-Ethernet connectivity, needs a very expensive, dedicated 45Mbs transport system!

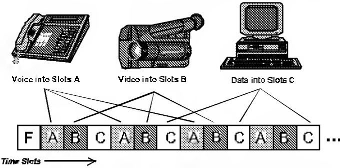
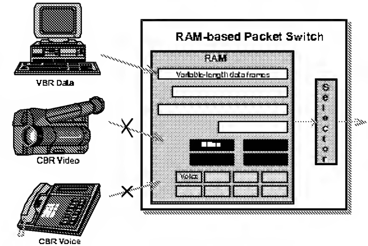


Exhibit A
Appli. No.: 09/976,004

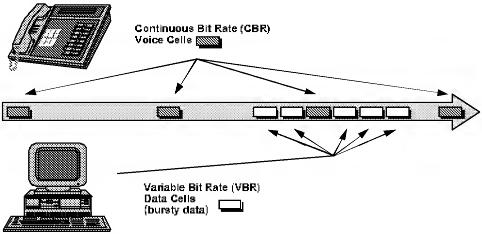
### Packet Switching




Packet transfer technologies provide statistical multiplexing of frames onto the transport medium. This is ideal for bursty, ***Variable Bit Rate*** (VBR) data transport, but for constant bit rate voice and video it can cause a relatively high fixed delay as well as uncertain queueing delays.

The TDM system described above was designed for voice transport, and is only marginally effective for data transport. In the same way, packet switches were designed for data transport, and are even less capable of effective CBR transport.

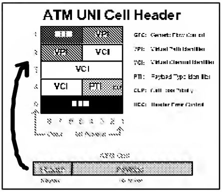
### ATM can provide both CBR and VBR transport




ATM Cell Relay is a packet switching technology that can provide high quality CBR service as well as economical VBR transport. Unlike TDM systems, it can provide an almost unlimited range of bit rates. In the example shown, CBR service is provided by allocating equally spaced slots. Data cells can fill up the remaining bandwidth.

## ATM Cells

# Exhibit A
# Appli. No.: 09/976,004

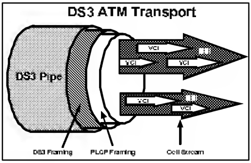


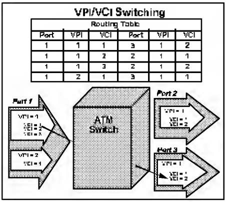

### Looking at ATM from the Inside-Out

We discussed a few of the "big-picture" ATM issues in the previous article. Now let's look from the inside-out, at the one thing that truly differentiates ATM: the cell. Each field of the cell header will lead us to an important understanding of ATM cell transport and switching.

### VPIs/VCIs

First notice the two fields VPI & VCI which contain the Virtual Path and Virtual Channel Identifiers. Paths and Channels are ***Virtual*** because the ATM network provides transport and switching services that can mimic existing TDM Constant Bit Rate and Packet Switched Variable Bit Rate Channels. ***Paths*** and ***Channels*** are separated because ATM networks provide a two-tiered approach to switching: Channels carry customer data, while Paths carry groups of Channels. A customer can bundle links (Channels) between two fixed sites into a single Path, allowing the ATM network to ignore the multiplicity of Channels, and thus provide the service for less cost. The ***DS3 ATM Transport*** figure shows the relationship of the DS3 transport pipe, DS3 framing, PLCP framing, VPIs, and VCIs.




| Port | VPI | VCI | Port | VPI | VCI |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 3 | 1 | 2 |
| 1 | 1 | 2 | 2 | 1 | 1 |
| 1 | 1 | 3 | 2 | 1 | 2 |
| 1 | 2 | 1 | 3 | 1 | 1 |

### VPI/VCI Switching

ATM switching is performed by routing incoming VPI/VCIs to different outgoing VPI/VCIs. Typically, this is performed using a hardware-based lookup table. The incoming cells have their VPI/VCIs overwritten with the new values, and the cells are then routed to the desired output port. Notice then that VPI/VCIs have only ***local*** significance, since they change at each switch point. So how does a customer's data reach the desired destination? In early ATM networks, virtual paths and channels are permanent (***Permanent Virtual Channels*** or PVCs). A PVC is created in a provisioning process that includes modifying the routing table of each ATM switch in the data path to provide the desired connection. Later ATM networks will use Signaling procedures to establish ***Switched Virtual Channels*** or SVCs, that can be set up or taken down when needed. Whether PVC or SVC, all ATM channels are ***connection oriented***, by which we mean that a "connection" must be established in the ATM network before data can be sent.

## Header Error Control

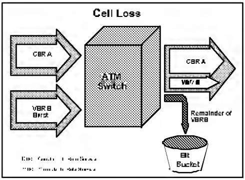
The ATM Cell Header is made extremely robust for transport by the ***Header Error Control*** (or HEC) field. This 8-bit field provides a checksum for the other 4 bytes of the header. The checksum can be used to detect errors with a high probability, or it can be used to correct single errors. For testing and monitoring purposes, the HEC is an easy method to determine line quality.

## Generic Flow Control

The Generic Flow Control field occurs only in cells at the ***User-Network-Interface*** or UNI. Its detailed use is still in the process of standardization, but its basic purpose is to provide metering and control of data entering the ATM Network ***before*** it enters, since the ATM Network does not provide store-and-forward buffering.

## Cell Loss Priority

Cell Loss is the natural reaction of ATM switches to congestion. Unlike TDM systems that reserve time-slots for all services, ATM networks are very flexible. High-priority video or voice services can reserve specific cell positions, while LAN-to-LAN data services will reserve system ***capacity***. Data is, however, bursty in nature, and maximum system efficiency can only be achieved by taking advantage of this. The Cell Loss Priority bit in each cell is settable by the ATM Network. An early use of this will be to tag those cells entering the network that exceed the customer's committed information rate ***(CIR)***. This will allow the network to discard those cells if needed.




## Payload Type Identifier

The main purpose of the PT Identifier is to discriminate between user cells and non-user cells such as ***Operation and Maintenance*** (or OAM) cells. OAM cells provide ***Layer Management*** features for the ATM Layer, and will be discussed in a future article.

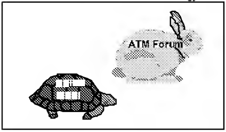
| PTI Coding | Interpretation |
|---|---|
| 000 | User data cell, congestion not experienced, SDU-type = 0 |
| 001 | User data cell, congestion not experienced, SDU-type = 1 |
| 010 | User data cell, congestion experienced, SDU-type = 0 |
| 011 | User data cell, congestion experienced, SDU-type = 1 |
| 100 | Segment OAM F5 flow related cell |
| 101 | End-to-end OAM F5 flow related cell |
| 110 | Reserved for future traffic control and resource management |
| 111 | Reserved for future functions |

**Exhibit A**
**Appli. No.: 09/976,004**

# The ATM Forum UNI Specification

### What is the ATM Forum, and where are the *real* ANSI & CCITT Specs?

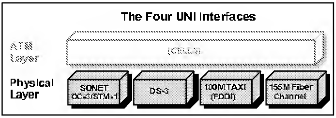
A short history lesson may help. In 1988 CCITT (now ITU) decided to base future B-ISDN (Broadband ISDN) service on ATM technology. As described in the previous article, ATM can provide transport and switching services equally well for both data and voice/video. B-ISDN/ATM was envisioned as a service/technology that would be researched during the 90s, and




implemented well past the turn of the century. The ANSI working group T1S1.5 worked on this as well. However, ATM technology has also been adopted by private network vendors who view it as the first technology where LAN and WAN can come together to provide data, voice, and video services. Four companies -- Adaptive, Northern Telecom, Sprint, and Cisco Systems founded the ATM Forum to ensure interoperability between the public and private ATM implementations. Their purpose was not to create standards, but to agree on which sets of specifications and options within them to use. Since August 1991 those four members have grown to nearly 400. Though not an official standards body, this group is making defacto ATM standards for the industry.

### Physical Layer Interfaces

An advantage of ATM is that ATM cells can be transported over almost any medium. The ATM Forum has defined the first four interfaces for the public and private User-Network Interface (UNI). They are 155 Mbps

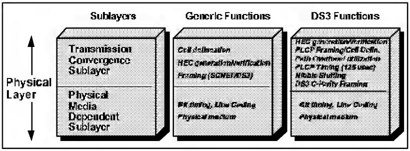



SONET, 45Mbps DS3, 100Mbps Multimode Fiber, and a second 155Mbps interface based on Fiber Channel. The SONET and DS3 interfaces are long-haul transport systems suitable for the User-to-Public-Network connection, while the other two are short/medium haul suited for LAN or campus backbones. Each physical layer standard is subdivided into a Physical Media Dependent Sublayer (PMD) and a Transmission Convergence Sublayer (TC). The PMD for each of the four interfaces comes directly from existing standards. The TC combines existing protocols required for network transport, such as DS3 and SONET framing, with new functions that transport cells within the payload of the existing system.

### DS3 Physical Layer

Standard asynchronous DS3 is made suitable for transporting cells by adding another layer of framing to the normal DS3 Frame pattern. This additional layer is called the Physical Layer Convergence Protocol (PLCP). Loosely modeled on SONET framing, PLCP provides a 125 usec multiframe, Cell Delineation, and many state of the art framing features like Bit Interleaved Parity, and Path Status that are not available in the DS3 framing structure.

**Exhibit A**
**Appli. No.: 09/976,004**




## Interim Local Management Interface (ILMI)

Easy management of ATM networks is a crucial feature. Central administrative authorities must be able to monitor the behavior and status of the network. The following is taken from the ATM Forum UNI Specification :

> ITU and ANSI are currently working on TMN standards, and are in large part considered "for further study" with respect to ATM. In the interim period, until these standards are available, the Simple Network Management Protocol (SNMP) and an ATM UNI Management Information Base (MIB) will be required to provide any ATM user device with status and configuration information concerning the Virtual Path and Channel Connections available at its UNI.

The types of management information that will be available in the ATM UNI MIB are: Physical Layer, ATM Layer, ATM Layer Statistics, Virtual Path (VP) Connections, Virtual Channel (VC) Connections, and Address Registration Information.

## UNI Signaling

ATM is a connection-oriented technology, requiring routing to be established before data can be exchanged. As discussed previously, initial ATM networks will have Permanent Virtual Channels (PVCs). Later networks will allow connections to be created when needed through a Signaling protocol based on the emerging CCITT Q.93B standard. A further tutorial will examine Signaling in detail. Here are the capabilities that Phase 1 Signaling, defined by the ATM Forum UNI specification, will provide.

1. Demand (switched) channel connections.
2. Point-to-point and point-to-multipoint switched channel connections.
3. Connections with symmetric or asymmetric bandwidth requirements.
4. Single-connection point-to-point or point-to-multipoint calls.
5. Basic signaling functions via protocol messages, information elements and procedures.
6. VPCI/VPI/VCI assignment
7. A single, statically defined out-of-band channel for all signaling messages.
8. Error recovery.
9. Public UNI and Private UNI addressing formats for unique identification of ATM endpoints.
10. A client registration mechanism for exchange of addressing information across a UNI.
11. End-to-end Compatibility Parameter Identification.

**Exhibit A**
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# The ATM Adaptation Layers

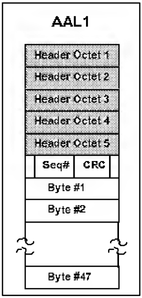
## Exhibit A
## Appli. No.: 09/976,004

### What is an *Adaptation Layer*?

| ATM Adaptation Type | 1 | 2 | 3/4 | 5 |
|---|---|---|---|---|
| Service Examples | CBR Speech<br>CBR Video<br>DS3/1 Emulation | Variabl e Bit-Rate Video | SMDS Connectionless Service | TCP/IP Bursty LAN data |
| Timing Relationship? | Yes | Yes | No | No |
| Bit Rate | Constant | Variabl e | Variable | Variable |
| Multiple Simultaneous Packets on a Single VCC? | N/A | No | Yes | No |

Described in previous articles, the PHY and ATM layers provide sequential transfer of fixed-size data units across a network. The ***ATM Adaptation Layer*** (AAL) adapts that transfer process to perform the upper layer services required by different users. The chart above shows four AAL types, each of which provides a different type of transport service. AAL1, 3/4, and 5 are described below. AAL2 is still in the standardization process.

### AAL1




The ATM Adaptation Layer 1 performs the functions necessary to adapt constant bit rate (CBR) services to the ATM Layer services. CBR voice, video and circuit emulation have certain characteristics in common:

- blocks of data appear at known, periodic intervals
- very intolerant of mis-sequenced data
- very intolerant of variation in delay
- somewhat tolerant of absolute delay

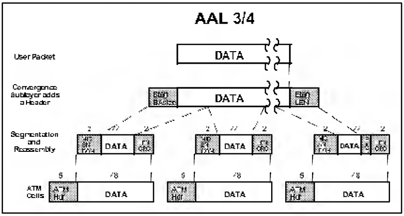
The basic AAL1 protocol shown to the right is very simple, with a single header preceding 47 bytes of data. The header's main job is to provide (error protected) sequence information for easy monitoring of cell loss or mis-sequencing. At the ATM layer, test equipment can monitor for cell delay variation, cell loss, and cell mis-sequencing to verify the quality of service across a network for AAL1.

### AAL3/4

AAL3/4 provides the transport of variable length frames with error detection. Since ATM is a connection-oriented technology, AAL3/4 most naturally provides connection-oriented service, but can also be used to provide ***connectionless service*** with the aid of a ***Connectionless Server***. This is where ATM and SMDS converge. Users of AAL3/4 will typically have

- bursty LAN traffic
- data is reasonably tolerant of variation in delay
- router may have several simultaneous datagrams to send across a single VC

Here are some points of interest in the AAL3/4 figure. The "MID" is a Message Identifier, which allows multiple simultaneous packets on a single VC. The "BOM", "COM", and "EOM" are beginning/continuation/end of message indicators for each packet. Connectionless service via an AAL3/4 must be provided by routing packets entering the network to a Connectionless Server, which could for instance provide SMDS. This server would then perform the routing of the packet through the connection-oriented ATM network. A single preassigned VPI/VCI address for all SMDS service assures that packets entering the network from any point will be routed to the nearest server.




**AAL5**

AAL5 is a simplification of AAL3/4 which limits the transport to connection oriented and single frame at a time. This removes the need for MID, COM, BOM, and EOM, which increases the efficiency of the protocol and makes its implementation much easier. There still is a need to recognize the frame boundaries, and this is done by using one of the Payload Type bits in the ATM header, indicated as "MORE" and "LAST" in the figure.

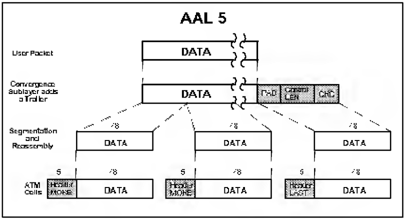



**Exhibit A**
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